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Effect of apples, tomatoes and dates on urinary acidity and blood alkali reserve

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EFFECT OF APPLES, TOMATOES AND DATES ON URINARY ACIDITY AND BLOOD ALKALI RESERVE

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INTRODUCTION

It is a well known physiological phenomenon that certain acid fruits, such as oranges or tomatoes, after passing through the body have an alkaline effect on the urine and increase the alkali reserve of the blood plasma. This effect is explained as being due to an excess of base forming elements which remain after the acids are oxidized in the body.

Certain other fruits, such as cranberries, have been found to have an opposite effect. Their ingestion results in a lowering of the urinary pH and also a lowering of the alkali reserve. This is due to the effect of aromatic acids such as benzoic acid and its precusor quinic acid. These acids are conjugated with glycine, which is thought to be synthesized in the liver, and so are excreted to lower the pH of the urine. Other organic acids such as tartaric are oxidized but not completely so, and, therefore, a fractional portion of the original fruit acid is excreted in the urine.

OBJECT

As most fruit acids are oxidized to carbon dioxide and water in the body, or otherwise utilized, the ash constituents, rather than the organic acids,are the more important factors regulating the acid-base balance of the body. This research was undertaken to determine the effect of apples, dates, and tomatoes on urinary acidity and blood alkali reserve. The results of this investigation should have a definite therapeutic

value in that the maintenance of an adaequate alkali reserve is of fundamental importance. Information as to the effects of fruits should be of value in the choice of diet in the case of acidosis.

REVIEW OF LITERATURE

Saywell(7) in his work on grape products found a decided increase in the pH value of urine, a decrease in ammonia and a corresponding decrease in total acidity. He reported an increase in the alkali reserve and a slight but apparent increase in organic acidity, which he explained as being due to some incompletely oxidized tartaric acid.

Saywell(8) also reported in another paper that figs had the same general effect as grape products. However, he found that 97.5 percent of the organic acids were oxidized before being eliminated from the system.

Blatherwick and Long (2) concluded that drinking large amounts of orange juice resulted in the production of an alkaline urine. Saywell(9) in his work on orange and tomato juices observed on the ingestion of these fruit juices, the same effects as were produced when grape products were used, including the increase in organic acidity. He found that there was a correlation between the alkalinity of the ash and the reaction of the urine. He also found that 82.5 percent of the total alkalinity of the tomato juice ash is derived from the water soluble ash, which is excreted in the urine, while the soluble alkalinity of the orange juice ash is only about 65

percent of the total alkalinity of the ash. Saywell (10) also reported that fresh Bartlet pears, canned peaches, canned apricots and dried sulfured apricots produced results in urine similar to those produced by grape products. He found that 94.7 percent was the average percentage oxidation of the organic acids of these foods. Blatherwick and Long (2) have shown that large amounts of orange juice produced an increase in pH with a decrease in the ammonia content of the urine.

Cleveland and Fellers (3) reported that the percentage of ash in dates, approximately 2 percent, is two or three times that of most foods which yield an alkaline ash. The alkalinity of the ash is high because of the large proportion of potash. Ash from 100 grams of a moisture free portion is equivalent to 16.7 cubic-centimeters of normal alkali. This can be compared with tomatoes, which have a value of 5.6 cubic centimeters and apples which approximate 3.7 cubic centimeters according to Sherman (11).

Blatherwick (1) found that the addition of raisins to an otherwise acid diet resulted in decreased acidity of the urine. He also reported, in the same paper, that tomatoes produced significant changes in the urine, the pH being increased and the ammonia excretion being decreased. Apparently, fresh whole tomatoes were used.

METHODS

Eight male human subjects in good health and from 22 to 27 years of age were used in this investigation. They are de-

signated as C, D, J, K, G, L, S, and F. Four subjects were placed on a daily basal diet which was approximately neutral. It consisted of:

Graham Crackers	300 g.
Milk (3 pints)	730 g.
Lettuce	120 g.
Heavy Cream (1/2 pint)	225 g.
Eggs (2)	140 g.

Five subjects were placed on a daily basal diet which was acid forming and consisted of:

Breakfast	grams	Lunch	grams	Supper	grams
Oatmeal	30	Salmon (red)	100	Peas (Iona)	191
Egg (1)	60	Bread	40	Beefsteak (cube)	150
Cream	30	Lettuce	105	Bread	40
Sugar	10	Cookies (plain)	60	Butter	28
Bread	40	Milk	250	Lettuce	105
Butter	14			Cookies	60
Milk	250				

The subjects were placed on their respective basal diets for a sufficient length of time to allow their tissues to reach equilibrium. This amounted to three to four days except in the case of the dates where the preliminary basal period was two days Then to these basal diets there was added a definite amount of the material to be tested, the amounts being, in general, much greater than would be ingested under normal conditions. The effect of this addition should be reflected in the urinary acidity and in the alkali reserve. The last two days of the diet period consisted again of the basal diet. No urine was collected during the first two or three days but 24 hour collec-

tions were made and analyzed at the end of each collection period on all subsequent days. The collection period was from 8 A.M. to 8 P.M.

As previously mentioned there were two diets, one acid and one approximately neutral. The neutral basal diet was chosen because the effects of the material to be added, on the urinary acidity could not be definitely foreseen. The acid forming basal diet was utilized because it was believed that the ingested material would increase the alkalinity of the urine, and because such a result would seemingly be more evident on an acid diet. This was thought to be especially true as regards the dates, the analyses of which showed an exceptionally high alkalinity of the ash.

Four different materials were tested in four different experiments. The first was run on McIntosh apples, the second on Baldwin apples, the third on tomatoes and the fourth on dates. Large quantities(800 and 1000 grams) of the first three materials and a smaller quantity (400 grams) of the dates were fed in these trials. The ratio of edible portion to pit is variable in the different varieties of dates, but at a definite moisture content is relatively constant for a given variety. The dates used were of the Hallowi variety and averaged 88 percent of flesh and 12 percent of pit.

The methods commonly used in urine analysis were employed. The pH was determined by using a quinhydrone potentiometer. Titratable acidity was determined by Folins' method which is

a simple titration of urine against tenth normal Sodium Hydroxide using phenolphthalein as an indicator. The organic acids were titrated using the Van Slyke and Palmer Technic (2). Urea nitrogen was determined by the urease method. (6) Ammonia nitrogen by the Folin and Bell method (4), and creatinine by Folin's method (5). The figures in the tables which represent the amounts of the determined constituents of urine are expressed in terms of grams per 24 hours in all cases except that of titratable acidity and organic acidity which are reported in cubic centimeters of tenth normal acid in 24 hours. The alkali reserve is expressed as cubic centimeters of carbon dioxide in 100 cubic centimeters of blood plasma.

Fitz and Van Slyke (13) have shown that in normal men "The excretion of acid in excess of fixed bases as measured by determining the ammonia and titratable acid bears a quantitative relationship to the alkali reserve of the body as measured by the CO_2 binding power of the blood plasma". They developed a formula by which, using data obtained from urine analyses, it is possible to calculate the alkali reserve of the blood plasma. In their studies with normal individuals, the value of the alkali reserve as determined in the urine usually had an average error of 3.2 volume percent.

The daily collections of urine were kept in a refrigerator to prevent bacterial decomposition. A small amount of toluene was added to help the preservative action.

Table A. Proximate Chemical Composition of the Edible Portion of Dates, Tomatoes and Apples

Calculated on a Moisture-free Basis

Fruit	Variety	Protein (N x 6.25)	Carbohydrate (extract matter)	Fat (ether extract)	Crude fiber	Ash	Alkalinity of ash *
		percent	percent	percent	percent	percent	
Tomato	Comet	24.80	54.83	2.68	8.80	8.89	55
Date	Hallowi	2.10	90.22	2.32	2.65	2.71	16.7
Apple	Baldwin	1.83	89.03	1.83	5.49	1.71	-
Apple	McIntosh	1.44	90.01	2.63	4.63	1.29	11

* Cubic centimeters of normal HCl required to neutralize 100 g. sample.

Table I. Effect of McIntosh Apples on Urinary Acidity and Blood Alkali Reserve. Acid Forming Diet

Date 1935	Subject	Weight of subject kg.	Urine volume 24 hrs. cc.	Sp.gr.	pH	Titratable * acidity cc.	Organic* acidity cc.	Creatinine gm.	NH_3 gm.	Urea gm.	Alk. reserve cc.	Diet
2/28	G	65.4	1015	1.042	5.5	540.6	692	1.50	.37	16.89	-	Basal
	St	71.8	1995	1.037	5.5	657.0	606	1.32	.20	18.90	-	"
3/1	G	65.9	864	1.054	5.3	641	535	1.58	.82	14.03	56	Basal
	St	71.8	1820	1.049	5.3	675	605	1.59	.64	18.23	62	"
3/2	G	66.3	895	1.056	5.5	503	601	1.18	.64	13.62	-	Basal+
	St	71.8	1885	1.039	5.4	732	617	1.66	.61	18.09	-	800 gms apples
3/3	G	66.3	1280	1.033	5.6	534	485	.80	.50	9.18	62	"
	St	71.8	2240	1.026	5.3	650	563	1.45	.66	15.73	63	"
3/4 ++	G	66.7	1310	1.034	5.6	648	611	1.03	.16	14.39	-	"
		71.8	2740	1.027	5.5	653	603	1.18	.65	17.95	-	"
3/5	G	66.9	1120	1.035	5.5	650	588	.99	.15	14.49	-	"
	St	71.8	2485	1.020	5.5	556	648	1.55	.29	16.59	-	"
3/6	G	67.0	970	1.039	6.0	425	609	1.09	.40	10.06	64	Basal
	St	72.0	1540	1.025	5.5	566	513	1.66	.61	14.67	63	"
3/7	G	67.0	926	1.038	5.4	602	639	1.08	.14	12.28	64	"
	St	72.0	2700	1.021	5.8	507	543	1.34	.21	17.38	68	"

++ Subject G had cold which continued through rest of experiment.

* cc. 0.1 N NaOH required to neutralize the volume of urine excreted in 24 hours.

Table II. Effect of McIntosh Apples on Urinary Acidity and Blood Alkali Reserve. Neutral Diet

Date 1935	Subject	Weight of subject kg.	Urine volume 24 hrs. cc.	Sp.gr.	pH	Titratable * acidity cc.	Organic* acidity cc.	Creatinine gm.	NH_3 gm.	Urea gm.	Alk. reserve cc.	Diet
3/20	F	69.5	1092	1.025	5.8	492	258	2.04	.084	12.67	66	Basal
	S	72.0	2475	1.013	6.2	245	320	2.77	.146	12.13	71	"
3/21	F	-	1380	1.025	5.9	458	395	1.45	.682	13.03	62	"
	S‡	-	2160	1.015	6.4	300	384	1.68	.377	11.74	69	"
3/22	F	-	1290	1.023	5.6	561	526	1.52	.485	14.51	62	Basal+
	S	-	1490	1.020	5.5	453	437	1.84	.508	9.43	62	1000 gms. apples
3/23	F	-	1150	1.024	6.2	390	434	1.50	.441	10.32	65	"
	S	-	2060	1.015	6.38	455	366	1.91	.371	10.17	67	"
3/24	F	-	1850	1.017	6.3	352	362	1.27	.456	9.61	67	"
	S	-	2085	1.014	5.8	483	516	1.23	.429	10.32	66	"
3/25	F	-	1010	1.025	6.2	393	396	1.56	.387	9.42	65	Basal
	S+++	-	1600	1.019	6.4	398	343	1.60	.299	8.51	69	"
3/26	F	69.5	1360	1.023	6.5	355	417	1.55	..353	11.28	67	"
	S	72.0	1790	1.020	6.45	298	469	1.64	.302	9.79	70	"

‡ Subject S had cold which continued until +++

* cc. 0.1 N NaOH required to neutralize the volume of urine excreted in 24 hours

Table III. Effect of Baldwin Apples on Urinary Acidity and Blood Alkali Reserve. Acid Forming Diet

Date 1937	Subject	Weight of subject kg.	Urine volume 24 hrs. cc.	Sp.gr.	pH	Titratable * acidity cc.	Organic* acidity cc.	Creatinine gm.	NH_3 gm.	Urea gm.	Alk. reserve cc.	Diet
3/21	D	72	900	1.027	5.80	374	272	1.06	.273	15.4	66	Basal
	J	82	1300	1.021	5.98	366	208	2.02	.406	17.4	67	"
3/22	D	72	910	1.025	5.60	467	391	1.19	.372	16.6	65	"
	J	82	940	1.028	5.60	476	328	2.59	.470	14.3	64	"
3/23	D	73	2040	1.015	5.47	515	423	1.23	.520	14.8	64	Basal+
	J	83	1210	1.029	5.58	568	404	2.48	.877	13.4	60	1000 gms. apples
3/24	D	73	1090	1.023	5.98	552	421	1.73	.491	13.5	62	"
	J	82	1300	1.028	5.41	705	462	2.53	.484	16.8	62	"
3/25	D	72	920	1.024	5.70	491	380	1.54	.476	15.6	62	Basal
	J	83	1325	1.025	6.65	394	396	2.12	.742	17.3	64	"
3/26	D	72	1185	1.026	5.97	547	378	1.86	.305	15.5	64	"
	J	82	1230	1.025	5.93	485	389	1.95	.524	18.1	65	"

* cc. of 0.1 N NaOH required to neutralize the volume of urine excreted in 24 hours

Table IV. Effect of Baldwin Apples on Urinary Acidity and Blood Alkali Reserve. Neutral Diet

Date 1937	Subject	Weight of subject kg.	Urine volume 24 hrs. cc.	Sp.gr.	pH	Titratable * acidity cc.	Organic* acidity cc.	Creatinine gm.	NH_3 gm.	Urea gm.	Alk. reserve cc.	Diet
3/21	C	66	810	1.026	5.85	305	289	1.30	.289	11.13	67	Basal
	K	67	940	1.022	6.16	248	213	1.09	.358	16.12	68	"
3/22	C	66	805	1.029	5.55	458	357	1.26	.309	12.54	64	"
	K	67	700	1.031	6.1	330	330	1.01	.274	18.33	66	"
3/23	C	67	1025	1.024	5.78	420	438	1.56	.331	14.41	65	Basal+
	K	67	1210	1.015	5.98	580	334	1.08	.358	17.26	63	1000 gms. apples
3/24	C	66	1690	1.016	5.23	702	526	1.48	.490	13.62	62	"
	K	67	1220	1.019	5.41	514	365	1.16	.334	16.91	64	"
3/25	C	65	1190	1.023	6.12	243	376	1.33	.219	12.32	69	Basal
	K	67	1185	1.018	6.25	241	396	1.12	.238	15.18	70	"
3/26	C	66	1373	1.019	6.47	271	302	1.62	.321	14.22	69	"
	K	66	950	1.021	6.58	327	292	.95	.417	15.46	67	"

* cc. of 0.1 N NaOH required to neutralize the volume of urine excreted in 24 hours.

Table V. Effect of Tomatoes on Urinary Acidity and Blood Alkali Reserve. Acid Forming Diet

Date 1937	Subject	Weight of subject kg.	Urine volume 24 hrs. cc.	Sp.gr.	pH	Titratable * acidity cc.	Organic* acidity cc.	Creatinine gm.	NH_3 gm.	Urea gm.	Alk. reserve cc.	Diet
4/22	D	73	1040	1.028	5.65	634	607	1.56	.380	14.14	62	Basal
	L	78	1080	1.025	5.88	532	562	1.65	.418	14.69	64	"
4/23	D	73	940	1.027	6.19	352	440	1.44	.490	7.29	65	"
	L	77	1020	1.029	6.28	520	535	1.53	.711	15.45	60	"
4/24	D	73	1240	1.028	6.49	576	508	1.57	.402	17.36	64	Basal + 1000 grams tomatoes
	L	77	1175	1.029	6.22	739	724	1.70	.306	23.03	62	
4/25	D	73	950	1.028	5.54	617	629	1.31	.545	19.4	60	"
	L	77	1030	1.027	5.69	695	746	1.30	.735	17.46	58	"
4/26	D	72	1000	1.030	5.63	739	740	1.62	.537	19.23	58	Basal
	L	77	1075	1.031	5.73	715	816	1.69	.736	17.33	58	"
4/27	D	73	1105	1.027	5.76	640	522	1.59	.569	17.56	60	"
	L	77	1040	1.029	5.78	753	517	1.55	.630	19.15	58	"

* cc. of 0.1 N NaOH required to neutralize the volume of urine excreted in 24 hours.

Table VI. Effect of Tomatoes on Urinary Acidity and Blood Alkali Reserve. Neutral Diet.

Date 1937	Subject	Weight of subject kg.	Urine volume 24 hrs. cc.	Sp.gr.	pH	Titratable * acidity cc.	Organic* acidity cc.	Creatinine gm.	NH_3 gm.	Urea gm.	Alk. reserve cc.	Diet
4/22	C	65	1165	1.019	6.18	369	466	1.18	.273	10.98	67	Basal
	K	67	1020	1.023	6.42	172	376	.83	.190	8.03	72	"
4/23	C	64	1475	1.018	5.87	386	414	1.42	.360	11.34	66	"
	K	67	1030	1.024	5.67	376	482	1.46	.487	10.96	64	"
4/24	C	65	1240	1.024	5.74	378	419	1.48	.226	13.33	67	Basal+
	K	68	1330	1.021	5.65	303	553	1.33	.533	13.17	66	1000 gms tomatoes
4/25	C	66	810	1.029	5.99	424	441	1.05	.364	12.09	64	"
	K	67	1455	1.018	6.48	554	629	1.26	.599	13.85	61	"
4/26	C	66	1010	1.026	5.79	547	703	1.31	.331	15.78	62	Basal
	K	67	930	1.028	6.12	406	713	1.33	.574	12.24	62	"
4/27	C	65	1150	1.023	6.08	452	372	1.41	.267	5.35	65	"
	K	66	920	1.021	6.32	331	492	1.26	.340	11.13	66	"

* cc. of 0.1 N NaOH required to neutralize the urine excreted in 24 hours.

Table VII. Effect of Dates on Urinary Acidity and Blood Alkali Reserve. Acid Forming Diet

Date 1937	Subject	Weight of subject kg.	Urine volume 24 hrs. cc.	Sp.gr.	pH	Titratable * acidity cc.	Organic* acidity cc.	Creatinine gm.	NH_3 gm.	Urea gm.	Alk. reserve cc.	Diet
4/26	D	72	1000	1.030	5.63	739	607	1.62	.537	19.23	58	Basal
	L	77	1075	1.031	5.73	715	562	1.69	.736	17.33	58	"
4/27	D	73	1105	1.027	5.76	690	440	1.59	.569	17.33	60	"
	L	77	1040	1.029	5.78	753	535	1.55	..630	19.15	58	"
4/28	D	73	1080	1.029	5.57	696	748	1.58	.628	16.87	58	Basal+
	L	78	840	1.033	5.08	602	652	1.03	.518	13.54	60	400 gms dates
4/29	D	74	880	1.032	5.67	536	713	1.32	.449	13.98	61	"
	L	78	1075	1.029	5.79	517	783	1.50	.527	14.72	63	"
4/30	D	74	1170	1.026	5.84	448	772	1.52	.672	14.32	62	Basal
	L	77	1080	1.023	5.77	502	778	1.23	.470	15.80	63	"
5/1	D	74	900	1.029	5.75	712	329	1.51	.500	11.33	59	"
	L	77	1280	1.028	5.73	698	878	1.31	.478	17.06	61	"

* cc. of 0.1 N NaOH required to neutralize the urine excreted in 24 hours.

Table VIII. Effect of Dates on Urinary Acidity and Blood Alkali Reserve. Neutral Diet

Date 1937	Subject	Weight of subject kg.	Urine volume 24 hrs. cc.	Sp.gr.	pH	Titratable * acidity cc.	Organic* acidity cc.	Creatinine gm.	NH_3 gm.	Urea gm.	Alk. reserve cc.	Diet
4/26	C	66	1010	1.026	5.79	547	703	1.31	.331	15.78	62	Basal
	K	67	930	1.026	6.12	406	713	1.33	.574	12.24	58	"
4/27	C	66	1150	1.023	6.08	552	372	1.41	.267	5.35	65	"
	K	66	920	1.024	6.32	331	497	1.26	.340	11.13	58	"
4/28	C	67	910	1.021	6.15	417	576	1.31	.294	10.23	65	Basal+
	K	66	900	1.023	6.25	411	577	1.19	.398	11.24	60	400 gms. dates
4/29	C	67	1030	1.028	6.28	465	674	1.21	.263	13.08	65	"
	K	69	880	1.032	5.67	371	605	1.08	.359	9.69	63	"
4/30	C	67	1120	1.023	6.28	478	582	1.24	.239	9.01	65	Basal
	K	68	1620	1.017	6.23	387	628	1.45	.349	10.7	63	"
5/1	C	-	-	-	-	-	-	-	-	-	-	-
	K	67	900	1.023	5,82	485	599	1.22	.395	11.1	61	Basal

* cc. of 0.1 N NaOH required to neutralize the urine excreted in 24 hours.

Table IX. Summary of Data on pH, Organic Acidity, Ammonia and Blood Alkali Reserve from Tables I - VIII

	Subject	pH		Org. Acidity c.c.		Ammonia gm.		Alk. Reserve c.c.	
		Acid	Neut.	Acid	Neut.	Acid	Neut.	Acid	Neut.
Basal	G&F *	5.55	6.1	619	366	.430	.376	61	65
"	St&S **	5.52	6.36	569	379	.420	.281	64	70
McIntosh apples 800 g.	G&F	5.55	6.0	571	441	.380	.345	62	65
	St&S	5.40	5.89	608	437	.540	.327	63	58
Basal	D&C	5.77	6.00	355	331	.358	.284	64	67
"	J&K	6.04	6.29	330	308	.535	.322	65	68
Baldwin apples 1000 g.	D&C	5.72	5.50	422	482	.505	.410	63	63.5
	J&K	5.50	5.70	433	350	.680	.346	61	63.5
Basal	D&C	5.81	5.98	577	489	.494	.308	61	65
"	L&K	5.92	6.13	608	518	.624	.398	60	66
Tomatoes 1000 g.	D&C	6.02	5.87	569	430	.474	.295	62	65.5
	L&K	5.95	6.07	735	591	.520	.566	60	63.5
Basal	D&C	5.75	6.05	537	552	.569	.279	60	64
"	L&K	5.75	6.12	688	609	.578	.414	60	60
Dates 400 g.	D&C	5.62	6.22	730	625	.538	.278	60	65
	L&K	5.44	5.96	709	591	.523	.378	61	61

*Subject G was on acid forming and subject F was on the neutral diet. The same order is used throughout this table.

**"St" refers to "S" when on an acid-forming diet. They refer to the same subject.

The proximate composition of the food materials used was determined in general by the official methods of analysis of the Association of Official Agricultural Chemists (1935 Edition). However, the alkalinity of the soluble ash, in the case of the tomatoes and McIntosh apples, was determined as follows. Two grams of the desiccated material were ashed at a low red heat. The residual ash was washed several times with boiling water and filtered. The filtrate was cooled and titrated with tenth normal HCL using methyl orange as an indicator. The results were expressed as the number of cubic centimeters of normal hydrochloric acid required to neutralize the alkalinity of 100 grams of ashed material. The data on composition are given in Table A.

DISCUSSION OF RESULTS

The data are presented in Tables I-IX. The Summary Table IX brings together the results in easily comparable form.

The results are largely negative in the case of Baldwin and McIntosh apples, tomatoes and dates regardless of whether an acid producing or a neutral basal diet was used.

The alkali reserve was not significantly affected by any of these fruits eaten in quantities of from 400 to 1000 grams.

The pH, organic acids and titratable acid values for the 24-hour samples of urine collected from the subjects showed some variations but no significant changes as a result of the fruit diets.

Apparently the organic acids of apples and tomatoes are readily oxidized or otherwise transformed in the body so that

very little is excreted in the urine. The results of Saywell and Lane (9) are discussed under the literature review in this paper. They found an oxidation of 90.7 percent in the organic acids of the tomato. An increase in urinary pH was also noted by them. No previous research has been reported on apples or dates.

In the acid producing diets, Baldwin apples, McIntosh apples, tomatoes and dates showed respectively, 89.3, 93.2, 84.0 and 75.9 percent utilization of the ingested fruit organic acids. In the neutral diet the percentages of the organic acids oxidized for Baldwin apples, McIntosh apples and tomatoes are 88.0, 88.3 and 90.8. The data on dates was of doubtful value and are not included. Saywell (7, 8, 10) states that the fruit organic acids appear to be "oxidized". Whether actual oxidation occurs is uncertain.

That is, even when massive amounts of fruits are eaten, approximately 90 percent of the organic acids present in them are oxidized or otherwise changed in the body and do not appear in the urine or blood as free acids. Whether actual oxidation occurs is uncertain, hence the term "oxidation" is probably not warranted.

There is also the possibility that some of the organic acids appearing in the urine may be synthesized in the body and excreted. If this is true, the assumption made by Saywell, and followed in this paper, that all the urinary organic acids found in the urine are derived from the fruit eaten, may not be entirely correct.

The blood alkali reserve data are particularly constant throughout these experiments. Only in the apple diet was there even a small reduction of this value. The greatest single reduction was in the case of McIntosh apples fed in the neutral diet. Here the drop was from 70 to 58 cubic centimeters. Attention is drawn to the remarkable similarity of the urine constants among the eight subjects used in these experiments.

SUMMARY

1. The proximate chemical composition of apples, tomatoes and dates is given.

2. In normal young human subjects Baldwin and McIntosh apples behave similarly when ingested in 800 and 1000 gram amounts. Both varieties lower slightly the pH of the urine, but do not significantly affect the blood alkali reserve in human subjects.

3. Approximately 90 percent of the organic acids of apples are completely oxidized or otherwise transformed in either acid forming or neutral diets.

4. Acid-forming and neutral diets gave similar results in these experiments insofar as acid and ammonia excretion in the urine and blood alkali reserve are concerned.

5. Tomatoes and dates have partically no effect on the composition of the urine nor on the blood alkali reserve. Neutral and acid-forming diets gave closely similar results.

6. Approximately 84 percent of the organic acids of the tomato were completely oxidized or otherwise transformed when tomatoes were included in an acid forming diet, while this value was 91 percent in the neutral diet.

7. Dates were eaten in smaller quantities than tomatoes and apples, and no significant results on the urine or blood alkali reserve were noted. In spite of the high alkalinity of the ash of dates, the pH of the urine was not increased nor the organic acids decreased in amount.

GENERAL CONCLUSION

Massive amounts of apples, tomatoes and dates may be eaten without significant effect on urinary acidity or blood alkali reserve.

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